National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA16CA512 09/06/2016 1030 CDT	**Regis# N519EP**	**Wilson, AR**	**Apt: N/a**
Acft Mk/Mdl AIR TRACTOR AT802	**Acft SN 802-0263**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl PRATT & WHITNEY PT6A-65AG	**Acft TT 633**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: EMPTY POCKETS FLYING SERVICE	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: SPR

Summary

According to the pilot, he was on his sixth agricultural application pass of the third field for the day. He reported that, during that pass, the airplane's tail struck "unseen powerlines." He recalled that the power lines crossed the field at an angle and that the power line poles were hidden by trees on both sides of the field. The pilot flew to a nearby airport and landed without further incident. The vertical stabilizer and the rudder sustained substantial damage.

Title 14 Code of Federal Regulations Part 137.19 (e) states, in part,

Knowledge and skill tests. The applicant must show, or have the person who is designated as the chief supervisor of agricultural aircraft operations for him show, that he has satisfactory knowledge and skill regarding agricultural aircraft operations, as described in paragraphs (e)(1) and (2) of this section.

(1)(i) Steps to be taken before starting operations, including survey of the area to be worked. .

(1)(vi) Safe flight and application procedures.

During an interview with the operator, the investigator-in-charge (IIC) asked if documented training was provided to pilots regarding the location of wire hazards for the area of operation, and the operator responded that it did not provide this information to its pilots. At the request of the IIC, the operator agreed to provide documented, local area power line and obstacle avoidance training to pilots who perform application operations. The operator has completed the recommended training.

The pilot reported that there were no mechanical failures or anomalies with the airframe or engine that would have prevented normal operation.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to adequately survey the area of operation and his subsequent failure to maintain clearance from power lines during an agricultural application flight.

Events

1. Enroute - Low altitude operation/event
2. Maneuvering-low-alt flying - Collision with terr/obj (non-CFIT)
3. Other - Tailstrike

Findings - Cause/Factor

1. Personnel issues-Task performance-Planning/preparation-Flight planning/navigation-Pilot - C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Altitude-Not attained/maintained - C
3. Environmental issues-Physical environment-Object/animal/substance-Wire-Effect on operation - C
4. Organizational issues-Support/oversight/monitoring-Training-Initial training-Operator
5. Organizational issues-Support/oversight/monitoring-Documentation/record keeping-Personnel records-Operator

Narrative

According to the pilot, he was on his sixth aerial application pass of the third field for the day. He reported that during that pass, the airplane's tail struck "unseen powerlines". He recalled that the powerline wires crossed the field at an angle, and that the powerline poles were hidden by the trees on both sides of the field. The pilot flew to a nearby airport, and landed without further incident. The vertical stabilizer and the rudder sustained substantial damage.

In accordance with 14 CFR Part 137, Section 19, (e)(1)(i)(vi)

(a) General. An applicant for a private agricultural aircraft operator certificate is entitled to that certificate if he shows that he meets the requirements of paragraphs (b), (d), and (e) of this section. An applicant for a commercial agricultural aircraft operator certificate is entitled to that certificate if he shows that he meets the requirements of paragraphs (c), (d), and (e) of this section.

The agricultural aircraft operator is entitled to a commercial agricultural aircraft operator certificate if the operator can show that the knowledge and skills required by the Commercial Operator per paragraph (e) are complied with, which include:

(i) Steps to be taken before starting operations, including survey of the area to be worked.

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(vi) Safe flight and application procedures.

During an interview with the operator, the investigator-in-charge asked if documented training was provided to pilots regarding the location of wire hazards for the area of operation? The operator said, no. At the request of the investigator-in-charge, the operator agreed to provide documented, local area powerline wire and obstacle avoidance training to the pilots that are performing aerial application operations for the organization. The operator has completed the recommended training.

The pilot reported that there were no mechanical failures or anomalies with the airframe or engine prior to the wire strike, that would have prevented normal operation.

Accident Rpt# ERA16CA313 09/01/2016 1300 EDT	**Regis# N917PD**	**Rikers Island, NY**	**Apt: N/a**
Acft Mk/Mdl BELL HELICOPTER TEXTRON CANADA	**Acft SN 57148**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl PRATT & WHITNEY PW207D1	**Acft TT 1492**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR PUBU**
Opr Name: NEW YORK CITY POLICE DEPARTMENT	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: STN

Events

1. Maneuvering-hover - Abrupt maneuver

Narrative

The pilot was landing the helicopter on a nose-up slope when he "noticed the helicopter started to tilt aft." As the pilot "immediately" increased collective pitch and applied forward cyclic to abort the landing, 3 of 4 main rotor blades struck the wire strike protection system on the cabin roof, which resulted in substantial damage to the blades. Representatives from the helicopter manufacturer inspected the helicopter, replaced the 3 damaged rotor blades, and the helicopter was returned to service. According to the pilot, there were no mechanical deficiencies with the helicopter that prevented normal operation.

Accident Rpt# CEN14LA505 09/19/2014 847 CDT	Regis# N322QS	Conroe, TX		Apt: Lone Star Executive Airport CXO
Acft Mk/Mdl EMBRAER S A EMB-505	Acft SN 50500165	Acft Dmg: SUBSTANTIAL		Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl P&W CANADA PW535E		Fatal 0	Ser Inj 0	Flt Conducted Under: FAR 091
Opr Name: NETJETS SALES INC	Opr dba:			Aircraft Fire: NONE

Events

1. Landing-landing roll - Runway excursion

Narrative

HISTORY OF FLIGHT

On September 19, 2014, about 0847 central daylight time, an Embraer EMB-505 Phenom 300 airplane, N322QS, impacted a ditch after the airplane departed the end of the runway while landing at Lone Star Executive Airport (CXO), Conroe, Texas. Neither of the two airline transport-rated pilots were injured. The airplane was substantially damaged. The airplane was being operated by NetJets Aviation, Inc. (NetJets), as a 14 Code of Federal Regulations (CFR) Part 91 positioning flight. Instrument meteorological conditions existed at the airport at the time of the accident, and an instrument flight rules flight plan had been filed. The flight originated from Nashville International Airport, Nashville, Tennessee, at 0706.

According to the dispatch flight release paperwork, the pilot-in-command (PIC) and second-in-command (SIC) planned to land on runway 14, which was assumed to be wet. Before the flight, notices to airmen (NOTAMs) had been issued, which stated that the runway 14 threshold had been displaced 3,377 ft and that the instrument landing system (ILS) and RNAV instrument approaches were not available. Although the NOTAMs were included in the flight release paperwork, dispatch personnel overlooked them, which resulted in flight planning numbers predicated on the full length of runway 14.

According to cockpit voice recorder (CVR) information, at 0827:04, the pilots received the automatic terminal information service (ATIS) information, which indicated that the runway 14 takeoff and landing distance was 4,111 ft and that the ILS for runway 14 was out of service. The pilots calculated the runway length required for a wet runway landing and then chose to land on runway 1, which was the longer runway. The PIC stated that, during the approach, the flight encountered light rain but that the rain was moving from the northwest to the southeast, away from the airport and that this alleviated any concern about standing water on the runway. He added that both he and the SIC had previously landed the EMB-505 in moderate-to-heavy rain with no decrease in braking ability.

The CVR recorded the pilots briefing the approach and missed approach procedures. Subsequently, the tower controller cleared the runway 1 RNAV approach, and the pilots then discussed alternate airports in the area. At 0841:30, the tower controller cleared the airplane to land and stated that moderate-to-heavy rain was at the airport. The pilots conducted the Before Landing checklist and continued the approach. While continuing the approach with the SIC flying the airplane, they saw the runway at 600 ft above ground level, and the copilot disengaged the autopilot at 400 ft. At 200 ft, the SIC reduced the power and adjusted the altitude and airspeed for a stabilized approach with a maximum airspeed during the approach of 130 knots.

In his postaccident written statement, the PIC stated that the landing appeared normal and "smooth." The SIC stated that he began braking with half pressure and continued to increase the brake pressure to maximum, which was the normal braking procedure. Sounds recorded on the CVR consistent with the airplane touching down were heard at 0837:13, followed by the pilots stating that the airplane was not slowing down. The SIC stated, "brakes. Emergency brakes," followed by "nothin' man" and "I got nothin'." The PIC stated "where's the brakes," followed by "where are they?" The PIC then said "go.don't go sideways, don't go sideways." The airplane exited the departure end of the runway and continued about 400 ft through soft/muddy terrain before coming to rest half-way down a ditch.

According to the air traffic controller who witnessed the accident, the pilots flew the RNAV runway 1 approach and broke out of the clouds at the minimums for the approach. The controller stated that the airplane touched down just past the 1,000-ft marker on the runway and did not appear to decelerate as it continued down the runway.

PERSONNEL INFORMATION

PIC

The PIC held an airline transport pilot certificate with an airplane multiengine land rating and a commercial pilot certificate with airplane single-engine land and balloon ratings. He held type ratings in Cessna 500, 650, and 750; Embraer 505; and Hawker Siddeley HS-125 airplanes. A limitation on the EMB-505 type

rating was the requirement of an SIC.
The PIC's last flight check was in the EMB-505 on May 12, 2014. The PIC was issued a first-class Federal Aviation Administration (FAA) medical certificate on April 3, 2014, which contained the limitations that it was not valid for any class after October 31, 2014, and that he must wear corrective lenses. He had 13,466 hours of flight time, of which 322 hours were in EMB-505 airplanes.

SIC
The SIC held an airline transport pilot certificate with an airplane multiengine land rating and a commercial pilot certificate with an airplane single-engine land rating. He held type ratings in ATR-42, ATR-72, Cessna 750, Bombardier CL-65, and Embraer 505 airplanes. Limitations on the CL-65 type rating were SIC privileges only and circling approaches in visual meteorological conditions. A limitation on the EMB-505 type rating was the requirement of an SIC.
The SIC's last flight check was in the EMB-505 on May 12, 2014. The SIC was issued a first-class FAA medical certificate on July 22, 2014, with no limitations. He had 9,861 hours of flight time, of which 361 hours were in EMB-505 airplanes.

AIRCRAFT INFORMATION

The accident airplane was a twin-engine turbofan, low-wing airplane, serial number 50500165, manufactured in 2013. The airplane was type certificated as a 14 CFR Part 23 commuter category airplane and was configured for two flight crewmembers and seven passengers. The airplane was equipped with two Pratt & Whitney PW535E turbofan engines, each of which delivered 3,360 lbs of thrust.

The airplane was maintained in accordance with the manufacturer's inspection program. The last inspection was completed on July 2, 2014, at a total airframe time of 597.7 hours.

Brake System

The airplane's hydraulic brake system delivered hydraulic pressure to the brakes via input from the brake pedals. The hydraulic pressure to the brake system was supplied at a maximum of 3,000 pounds per square inch (psi). The SIC (right seat) brake pedals were mechanically linked to the PIC (left seat) brake pedals. Each PIC brake pedal was connected to a pedal position transducer (PPT), each of which produced two independent electrical outputs that were proportional to the respective pedal displacement to the brake control unit (BCU). The BCU controlled the main brake system, which was a brake-by-wire system with an antiskid function. The only pedal force feedback to the pilots was from a force spring installed on the pedals that provided a consistent pedal resistance regardless of the runway condition and the pressure applied.

Wheel speed information was sent to the BCU via two axle-mounted speed transducers. The BCU factored the output from the wheel speed transducers, the PPTs, and two brake line pressure transducers then sent an electrical command to the associated brake control valve.

The brake system had an antiskid function (which controls slip ratio) and a locked-wheel protection (which detects deep skids). The antiskid function worked independently on each wheel by comparing the current wheel angular speed to a reference angular speed, which was calculated based on the speed of that same wheel. The locked-wheel protection compared both main landing gear (MLG) wheel speeds and alleviated brake pressure when the slower wheel fell below 30% of the opposite wheel speed.

The airplane was equipped with an EPB to stop the airplane if the main brake system failed. The EPB was operated by a T-handle on the control pedestal, which was mechanically linked via a steel cable to the EPB valve. The antiskid function was not available when using the EPB.

An examination of the brake system and the data downloaded from the brake control unit (BCU) indicate that the brake system functioned as commanded during the landing.

Ground Spoiler Function

The airplane had a ground spoiler function that deployed the spoiler panels on the ground during landing to decrease lift, increase drag, improve braking, and reduce stopping distance. The airplane must be on the ground, the thrust levers must be in the "idle" position, and the ground spoilers must be armed for them to deploy during landing. The ground spoiler function automatically armed when the weight-on-wheels (WOW) sensors indicated "in-air" for more than 10 seconds and the airspeed was valid and greater than 60 knots indicated airspeed (KIAS).

Certification

In general, 14 CFR Part 23 certification regulations require that dry-runway landing distances be published in airplane flight manuals (AFM) and that they be based on performance demonstrated during flight tests on smooth, dry, hard-surfaced runways. Certification regulations do not require the publication of landing distances on other-than-dry runways, although certification applicants may choose to present this information to the regulator. If the applicant provided this information, it would not necessarily be based on flight tests (largely because of the difficulty of achieving a consistent "wet" or "contaminated" runway surface) but rather derived by calculations based on assumptions agreed to by the regulator.

The EMB-505 was first certificated by the Brazilian regulator (the Agˆncia Nacional de Aviacao Civil), which, like the FAA, does not require the publication of landing distances on other-than-dry runways. However, the European Aviation Safety Agency (EASA) does require the publication of landing distances on other-than-dry runways if the airplane is to be operated on such runways. Therefore, to certify the airplane in Europe, Embraer proposed to EASA that the unfactored wet-runway landing distances presented in the EMB-505 AFM would be computed as 125% of the demonstrated, unfactored dry-landing distance, and EASA accepted this proposal. The unfactored landing distance is the actual distance from the runway threshold required to land the airplane and stop it without any safety factors applied. The factored landing distance is the actual distance from the runway threshold required to land the airplane and stop increased by a safety factor.

The factored wet-runway distances in the EMB-505 AFM were 115% of the factored dry distances, or 192% of the unfactored dry distances. The EMB-505 AFM also provided a table of landing distances for landings on runways covered with standing water, slush, or wet snow at depths of 0.125, 0.250, and 0.375 inches.

METEOROLOGICAL INFORMATION

At 0841, the CXO automated surface observation system reported calm wind, visibility 2 miles in heavy rain and mist, a few clouds at 500 ft above ground level (agl), ceiling 8,000 ft agl broken, 10,000 ft agl overcast, temperature 23ø C, dew point 22ø C, and altimeter setting of 29.93 inches of Mercury. Remarks included the following: hourly precipitation 0.21 inch, temperature 22.8ø C, and dew point 22.2ø C.

A review of weather observations reported before and after the accident showed that the rain began at 0444. The rain varied from moderate-to-heavy intensity from 0725 until after the accident. The rain ended at 1129. The total precipitation reported between 0444 and 0847 (the time of the accident) was 0.45 inch. The total precipitation reported between 0444 and 1129 was 0.50 inch.

AIRPORT INFORMATION

CXO is located about 37 miles north of Houston, Texas. The airport is equipped with an air traffic control tower, which is operational between 0700 and 2200. The airport chart supplement lists an elevation of 245 ft and a magnetic variation of 5ø east. Runway 1/19 is 5,000 ft long and 100 ft wide, concrete, and in good condition with a threshold elevation of 230 ft and 0.2% grade. The runway has a medium-intensity approach lighting system and nonprecision runway marking. The runway also has a two-light precision approach path indicator lighting system, which was out of service.

Runway 14/32 was under construction at the time of the accident. As noted earlier, a NOTAM had been issued, which stated that the runway 14 threshold had been displaced 3,377 ft and that the ILS and RNAV instrument approaches were not available.

The dispatch Flight Release for N322QS, showed that the landing was planned for runway 14 which was assumed to be wet. The NOTAMs were included in the Flight Release paperwork, but were overlooked by dispatch resulting in flight planning numbers predicated on the full length of runway 14. The pilots became aware of the runway information during the flight and they opted to land on runway 01.

The automated terminal information service (ATIS) ZULU which was received by the crew reported the runway 14 takeoff and landing distance was 4,111 ft and the ILS for runway 14 was out of service.

WRECKAGE AND IMPACT INFORMATION

According to the FAA inspector who arrived on scene shortly after the accident, there were light tire scuffmarks on runway1, which began 1,877 ft before the departure end of the runway. There were no visible signs of rubber transfer on the runway. The airplane exited the departure end of the runway and continued about 400 ft through soft/muddy terrain before coming to rest on down-sloping terrain. The distance between the ground tracks made by the nose tire and the right MLG gear track was 18 inches, indicating that the airplane skidded after it departed the runway surface. A flat worn spot was visible on both the left and right main tires. Both tires showed evidence of reverted rubber hydroplaning.

The airplane contacted a silt/erosion control fence during the overrun. The nose landing gear collapsed and separated from the airplane just before it came to rest.

The airplane sustained substantial damage, including, but not limited to, damage to the forward bulkheads, composite ribs, forward fuselage frame, and the center fuselage area.

Power was applied to the airplane after the accident, and a ground hydraulic power stand was used to generate a hydraulic system pressure of 2,850 psi. The brakes and spoiler system were tested, and both functioned normally. The antiskid auto-startup test was completed with no faults noted.

TESTS AND RESEARCH

BCU and Central Maintenance Computer (CMC)
The BCU, serial number 276920254, was removed from the airplane and sent to Meggitt in the United Kingdom. The recorded faults were downloaded, and the BCU was functionally tested under the supervision of an investigator from the Air Accidents Investigation Branch, and it functioned normally.

Embraer downloaded the CMC messages on scene with the concurrence of the National Transportation Safety Board (NTSB) investigator-in-charge. The BCU faults and CMC faults and messages were correlated with one another and reviewed by Embraer. Although the BCU and CMC recorded four sequences of faults and messages, the data and the examination of the brake system indicated that the brake system functioned as commanded during the landing.

FLIGHT RECORDERS

The airplane was equipped with an L-3/Fairchild FA2100-3083 combination cockpit voice and flight data recorder (CVDR), serial number 000885510, which provided both flight data recorder (FDR) and cockpit voice recorder (CVR) functions. The CVDR was removed from the wreckage and examined at the NTSB Vehicle Recorder Laboratory, Washington, DC. The CVR contained 2 hours 4 minutes 14 seconds of good quality voice recordings. A CVR group was convened, and a transcript was prepared for the period from 0824:47 to 0848:01.

FDR Data

The FDR contained 222 hours of data. Timing of the FDR data is measured in subframe reference numbers (SRN), where each SRN equals 1 lapsed second. The accident flight was the last flight on the recording, and the flight duration was about 1 hour 37 minutes.

The FDR data showed the airplane initially on approach above 150 knots. From 0844:18 to 0844:38, the flap position increased from flap position "one" through to flap position "three," at which position it remained for the rest of the approach. At 0844:43, the brake pressure for the left and right MLG briefly spiked to about 3,000 psi and quickly returned to 0. During this time, the pilot brake pedal position remained near 0. The airplane continued the approach, and its approach speed steadily decreased to about 130 knots while on short final.

At 0847:09, the brake pedal position parameters became active, and they began to increase just before touchdown. One second later, the left and right main wheel spin became active and then increased rapidly. Two seconds later, the speed brakes began to extend, and they reached maximum extension at 0847:14. About the same time, all four WOW discrete parameters became true. Between 0847:14 and 0847:24, the brake pressure for both MLG remained below 1,000 psi. During this time, the pilot left and right brake pedal positions increased to about 36 millimeter (mm) of pedal travel as the indicated airspeed, groundspeed, and wheel speed for both MLG steadily decreased. At 0847:24, the EPB discrete became active. Immediately thereafter, the brake pressure for both MLG plateaued near the system's maximum value of 3,000 psi, and the wheel speed quickly decreased to about 0 knots.

Between 0847:27 and 0847:42, the brake pressure for both MLG remained plateaued about 3,000 psi. The pilot left and right brake pedal positions also remained steady about 35 mm of pedal travel as the KIAS and groundspeed continued to decrease. At 0847:24, a brake fail indicator discrete became active as the brake pressure for both MLGs dropped to 0 psi, and the pilot left and right brake pedal positions remained near the system's maximum pedal travel value while the airplane was experiencing measurable changes in tri-axis acceleration, consistent with it departing the runway surface. KIAS and groundspeed quickly dropped to about 0 knots, and the speed brake surface positions for the left and right speed brakes bleed position decreased to 0. The FDR recording ended at 1347:59 and showed the airplane at rest.

Airplane Performance Study

The NTSB conducted an airplane performance study for the accident flight to determine the airplane's position and orientation during the relevant portion of the flight and its responses to control inputs, external disturbances, ground forces, and other factors that could affect its trajectory.

According to the performance study, the airplane's approach to runway 1 complied with the operator's stabilized approach criteria, with the airplane tracking the RNAV final approach course and glideslope at an airspeed of about 130 knots. The airplane crossed the runway threshold at 121 knots (9 knots faster than Vref) and 45 ft above the runway and touched down about 903 ft from the threshold at a groundspeed of 118 knots. The headwind component at touchdown was negligible.

After touchdown, the pilot brake pedal deflections progressively increased to maximum braking in about 11 seconds, and the airplane achieved a maximum deceleration of about -0.17 G at 0847:17, about 7 seconds after touchdown. Between 0847:19 and 0847:22, the deceleration increased briefly and then decreased until about 0847:23.5, 13.5 seconds after touchdown, as the wheel speeds decreased to 0, consistent with the application of the EPB and the beginning of a full, locked-wheel skid. The wheels remained locked until the airplane came to rest. During the skid, the deceleration steadily increased, before decreasing again to as the airplane passed the end of the runway at 0847:37.4. The airplane exited the runway about 27 seconds after touchdown at a groundspeed of about 61 knots.

The performance study determined that, after the airplane touched down, the computed braking friction coefficient increased steadily as the brake pedals were depressed, reaching a peak of about 0.16 before decreasing steadily to about 0.06 after the EPB was applied and the airplane entered a full, locked-wheel skid; this decrease is consistent with research indicating that the braking friction achieved in a full locked-wheel skid (a braking slip ratio of 1.0) is significantly less than the maximum braking friction coefficient that can be achieved at lower slip ratios. However, even before the EPB was applied, the computed braking friction coefficient was significantly lower than what would have been predicated using models prescribed in 14 CFR Part 25 for computing accelerate-stop distances on a wet runway. The braking friction coefficient was also significantly lower than that implied by the unfactored, wet runway landing distances published in the EMB-505 POH, which are computed as 25% greater than the unfactored (demonstrated) landing distances on a dry runway.
"However, the braking friction coefficient achieved during the accident was consistent with the predicted braking friction coefficient using a National Aeronautics and Space Administration (NASA) model that is based on runway friction measurements taken with a Ccontinuous Ffriction Mmeasurement Eqequipment (CFME) device."

"The decrease in braking friction coefficient after the EPB was applied is consistent with research indicating that the braking friction achieved in a full locked-wheel skid (a braking slip ratio of 1.0) is significantly less than the maximum braking friction coefficient that can be achieved at lower slip ratios .."

As part of the performance study, the NTSB and the parties to the investigation conducted tests on runway 1 at CXO to measure the runway macrotexture depth and the cross slope. Based on the results of the runway tests, the performance study determined, taking into account a rainfall rate of 0.3 inch per hour and the runway macrotexture and cross slope, the accident landing gear would have encountered a maximum water depth of about 0.006 inch, which was far below the 3 mm (0.017 inch) that the EASA Acceptable Means of Compliance 25.1591 considered a "flooded" runway. Therefore, it is unlikely that the accident airplane experienced dynamic hydroplaning during the landing and that the low wheel braking friction coefficient levels resulted from viscous hydroplaning, which is associated with the buildup of water pressure due to viscosity.

The Phenom 300 Quick Reference Handbook (QRH) provided landing distance tables for various aircraft configurations and runway conditions. The QRH showed the unfactored runway distance required for a landing weight of 15,483 lbs and flaps 3 configuration to be 2,541 ft for a dry runway, 2,922 ft for a wet runway, and 4,885 ft for a contaminated runway (1/8-inch-deep water).

The performance study determined that, if the EPB had not been set and the braking friction had continued at levels attained early in the landing roll, then the airplane would have come to a stop about 4,669 ft from the threshold with 331 ft of runway remaining. The study noted that this level of braking friction is considerably lower than that underlying the wet runway landing distance in the AFM and is also lower than that specified by a wet runway model used in FAA advisory circulars (AC) and Part 25 certification regulations. Although the expected stopping distance of 4,669 ft was close to the EMB-505 AFM "contaminated (1/8 in water)" distance of 4,885 ft, the study noted that the runway characteristics and rainfall rate on the day of the accident precluded this runway condition. The study concluded that the braking friction deficit observed in this and other accidents examined during the course of this investigation showed that the airplanes' stopping performance was more consistent with AFM landing distances for runways contaminated with standing water than for runways that were merely "wet" even though it was determined that the runways involved could not have been flooded

The performance study also noted that, although the achieved braking friction was lower than that specified by the model used in the FAA regulations and ACs for a wet runway, the FAA model friction level was closer to the achieved friction than the friction level implied by the wet-runway landing distances in the EMB-505 AFM. That is, the friction implied by the AFM wet-runway landing distances was even higher than that predicted by the FAA model, whereas the FAA model itself overpredicted the friction level for this accident. Further, Embraer provided data that showed the deceleration recorded for the time interval before the EPB was applied during the accident flight was consistent with the results obtained from a simulation using the optimized performance analyzer software based on the expected brake coefficient prescribed in AMC 25.1591 for standing water contamination (3 mm) and contaminated drag based on flight test data produced for EASA certification purposes.

The performance study concluded that, based on the runway characteristics and rainfall rate at the time of the accident, the water depth on the runway was well below 3 mm but that the braking friction coefficient achieved before the EPB was engaged closely matched that modeled for a water depth greater than 3 mm. Therefore, the circumstances of this accident indicate that some wet runways may provide friction levels closer to those used to model flooded runways than to those implied in the AFM wet runway landing distances even when the runway is not flooded.

See the Airplane Performance Study in the docket for this accident for additional details.

ADDITIONAL INFORMATION

NetJets Flight Operations Manual (FOM) and AFM Landing Distance Information
NetJets' FOM states that "every landing requires an adjustment to planned landing distance. The type of operation [that is, Part 91, 91K, or 135] dictates which adjustments are applied." The "planned landing distance" is the unfactored AFM dry landing distance for the airplane. The FOM defined a contaminated runway as one in which more than 25 percent of the required runway length, within the width being used, is covered by standing water or slush deeper than 1/8 inch or accumulation of snow or ice and a wet runway as one in which its surface is reflective.

For dispatching a flight to a runway that is expected to be wet at the time of arrival, the FOM stated that, for Part 91 flights, the required landing distance is the unfactored wet landing distance specified in the AFM's FAA-approved landing performance data or the AFM's advisory data with no safety factor applied. However, in practice, NetJets dispatchers divided the unfactored AFM distance by 0.8, which resulted in a required landing distance greater than that specified in the FOM. For Parts 91K and 135 flights, the required landing distance was the unfactored dry landing distance from the AFM, divided by a safety factor of 0.6 with an additional safety factor of 15% applied.

For all operations, the FOM also required pilots to perform a landing performance assessment to recalculate the required landing distance "if weather, runway surface condition, aircraft status, or any other relevant factor has degraded from those shown in the flight release package." An additional safety factor of 15% must then be added to the recalculated distance.

The Embraer AFM, "Landing Technique," stated that the performance data are based on the following:

- Steady three degree angle approach at Vref in landing configuration;
- Vref airspeed maintained at runway threshold;
- Idle thrust established at runway threshold;
- Attitude maintained until MLG touchdown;
- Maximum braking applied immediately after MLG touchdown;
- Antiskid system operative.

NetJets Aircraft Operations Manual Arrival Briefing Information

NetJets Aircraft Operations Manual, Section 2.3.4, "Arrival Briefing," stated that, before conducting the arrival briefing, the crew should, if able, obtain the destination weather and landing information and program the flight management system (FMS). The pilot flying should transfer aircraft control and verify the FMS inputs and brief items pertaining to the arrival, including the arrival procedure (include altitude and airspeed constraints), NOTAMS, runway conditions, and landing performance assessment. These same items are also listed on the NetJets Normal Procedures Checklist under the Arrival Briefing section.

14 CFR Part 23 Certification Regulations

In accordance with 14 CFR Part 23 Section 23.75, "Landing distance,"

The horizontal distance necessary to land and come to a complete stop from a point 50 feet above the landing surface must be determined, for standard temperatures at each weight and altitude within the operational limits established for landing, as follows:
(a) A steady approach at not less than VREF, determined in accordance with ⊥23.73 (a), (b), or (c), as appropriate, must be maintained down to the 50 foot height and-
(1) The steady approach must be at a gradient of descent not greater than 5.2 percent (3 degrees) down to the 50-foot height.
(2) In addition, an applicant may demonstrate by tests that a maximum steady approach gradient steeper than 5.2 percent, down to the 50-foot height, is safe. The gradient must be established as an operating limitation and the information necessary to display the gradient must be available to the pilot by an appropriate instrument.
(b) A constant configuration must be maintained throughout the maneuver.
(c) The landing must be made without excessive vertical acceleration or tendency to bounce, nose over, ground loop, porpoise, or water loop.
(d) It must be shown that a safe transition to the balked landing conditions of ⊥23.77 can be made from the conditions that exist at the 50 foot height, at maximum landing weight, or at the maximum landing weight for altitude and temperature of ⊥23.63 (c)(2) or (d)(2), as appropriate.
(e) The brakes must be used so as to not cause excessive wear of brakes or tires.
(f) Retardation means other than wheel brakes may be used if that means-
(1) Is safe and reliable; and
(2) Is used so that consistent results can be expected in service.
(g) If any device is used that depends on the operation of any engine, and the landing distance would be increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of other compensating means will result in a landing distance not more than that with each engine operating.

Section 23.1587, "Performance Information," stated the following:

(a) For all airplanes, the following information must be furnished-
.
(3) The landing distance, determined under ⊥23.75 for each airport altitude and standard temperature, and the type of surface for which it is valid;
(4) The effect on landing distances of operation on other than smooth hard surfaces, when dry, determined under ⊥23.45(g); and
(5) The effect on landing distances of runway slope and 50 percent of the headwind component and 150 percent of the tailwind component.

FAA Safety Alert for Operators (SAFO)

The FAA had previously issued two SAFOs that were relevant to the circumstances of this accident. SAFO 06012, "Landing Performance Assessments at Time of Arrival (Turbojets)," dated August 31, 2006, stated the following:

This SAFO urgently recommends that operators of turbojet airplanes develop procedures for flightcrews to assess landing performance based on conditions actually existing at time of arrival, as distinct from conditions presumed at time of dispatch. . Once the actual landing distance is determined an additional safety margin of at least 15% should be added to that distance.

SAFO 06012 noted that, the dry-runway landing distances established during flight test and that are the basis for the factored landing distances used by dispatch, are shorter than the landing distances achieved in practice. In addition, AFM landing distances for wet and contaminated runways may also be based on the minimum dry distances obtained during flight tests. Consequently, landing distances on wet or contaminated runways computed from AFM data with little or no additional safety margin may be too short for normal operations. The SAFO recommended a conservative approach to assessing the landing distance requirements, including using the most adverse reliable braking action report or expected conditions for the runway and using values for air distances and approach speeds that are representative of actual operations. The SAFO recommended that a 15% safety margin then be added to the computed (unfactored) landing distance because "the FAA considers a 15% margin between the expected actual airplane landing distance and the landing distance available at the time of arrival as the minimum acceptable safety margin for normal operations."

SAFO 15009, "Turbojet Braking Performance on Wet Runways," dated August 11, 2015, warned that "the advisory data for wet runway landings may not provide a safe stopping margin under all conditions" and stated the following:

Several recent runway landing incidents/accidents have raised concerns with wet runway stopping performance assumptions. Analysis of the stopping data from these incidents/accidents indicates the braking coefficient of friction in each case was significantly lower than expected for a wet runway as defined by the Federal Aviation Administration (FAA) in Federal Air Regulation (FAR) 25.109 and Advisory Circular (AC) 25-7C methods. These incidents/accidents occurred on both grooved and un-grooved or non-Porous Friction Course overlay (PFC) runways. The data indicates that applying a 15% safety margin to wet runway time-of-arrival advisory data, as recommended by SAFO 06012, may be inadequate in certain wet runway conditions.

The root cause of the wet runway stopping performance shortfall is not fully understood at this time; however, issues that appear to be contributors are runway conditions such as texture (polished or rubber contaminated surfaces), drainage, puddling in wheel tracks and active precipitation. Analysis of this data indicates that 30 to 40 percent of additional stopping distance may be required in certain cases where the runway is very wet, but not flooded.. Possible methods of applying additional conservatism when operating on a runway which experience has shown degraded when very wet are assuming a braking action of medium or fair when computing time-of-arrival landing performance or increasing the factor applied to the wet runway time-of-arrival landing performance data.

Advisory Circular 91-79A

The FAA issued AC 91-79A, "Mitigating the Risks of a Runway Overrun Upon Landing," on September 17, 2014. The AC stated the following:

DISCUSSION - HAZARDS ASSOCIATED WITH RUNWAY OVERRUNS
j. A Wet or Contaminated Runway. Landing distances in the manufacturer-supplied AFM provide performance in a flight test environment that is not necessarily representative of normal flight operations. For those operators conducting operations in accordance with specific FAA performance regulations, the operating regulations require the AFM landing distances to be factored to ensure compliance with the pre-departure landing distance regulations. These factors should account for pilot technique, wind and runway conditions, and other items stated above. Pilots and operators should also account for runway conditions at the time of arrival (TOA) to ensure the safety of the landing. Though the intended audience of SAFO 06012 is turbojet airplanes, it is highly recommended that pilots of non-turbojet airplanes also follow the recommendations in SAFO 06012.

NTSB Safety Recommendations
As a result of previous accidents, the NTSB had issued Safety Recommendations A-07-57 and 61. Safety Recommendation A-07-57 asked the FAA to immediately require all 14 CFR Parts 121, 135, and 91 subpart K operators to conduct arrival landing distance assessments before every landing based on existing performance data, actual conditions, and incorporating a minimum safety margin of 15 percent. Safety Recommendation A-07-61 asked the FAA too require all 14 CFR Parts 121, 135, and 91 subpart K operators to accomplish arrival landing distance assessments before every landing based on a standardized methodology involving approved performance data, actual arrival conditions, a means of correlating the airplane's braking ability with runway surface conditions used the most conservative interpretation available, and including a minimum safety margin of 15 percent. Safety Recommendation A-07-57 is currently classified "Closed-Unacceptable Action," and Safety Recommendation A-07-61 is currently classified "Open-Unacceptable Response." See the Airplane Performance Study in the docket for this accident for additional details.
Postaccident Safety Actions

Netjets Actions

On September 11, 2015, NetJets issued Flight Operations Bulletin (FOB) 15-06, "Landing Considerations for Wet Untreated Runways." The FOB instructed pilots to determine if the runway had a treated (grooved or porous friction) overlay during the arrival briefing. It added that pilots should conduct a landing performance assessment using the AFM contaminated runway performance data for the lowest contamination depth when the following three conditions existed: 1) the runway does not have a treated surface, 2) thrust reversers are deferred or not installed, and 3) the airport is reporting rain or heavy rain.

On December 14, 2016, NetJets issued FOB 14-12, "Use of Emergency Braking." The FOB instructed pilots to continue to use normal antiskid braking unless there is a positive indication of a brake system failure, at which time, they should apply corresponding aircraft AFM or QRH procedures.

In addition, NetJets added the following to its AOM:

2.26.4 Ground Spoilers
Ground Spoilers are deployed automatically upon touchdown with thrust levers at idle.

Deployment failure of spoilers causes reduced normal braking effectiveness and may be misinterpreted as a brake failure. Do not engage the emergency brake system unless total brake failure is indicated (i.e., EICAS [engine indication and crew alerting system] message of a failed system affecting normal braking).

2.26.5 Braking
For optimum braking efficiency, smoothly apply constant brake pressure after touchdown of the main landing gear. Do not pump brakes.

On short of slippery runways, apply maximum braking. Maintain steady and increasing brake pressure, allowing the anti-skid system to function.

NetJets highlighted runway excursions as part of its flight crew training, and the factual information developed in this investigation was used as part of the training. In addition,
NetJets worked with Flight Safety International to enhance its brake and antiskid systems training.

Embraer Actions

On November 5, 2014, Embraer issued Flight Operation Letter (FOL) PHE505-018/14, "Landing Procedure Best Practices and Recommendations." Revision 1 was issued on August 14, 2015, and Revision 2 was issued on June 6, 2016. The FOL highlighted some information contained in FAA AC 91-79A and added information specific to the Phenom fleet. The letter stated that, due to the antiskid function, the BCU will automatically calculate the maximum pressure delivered to the brakes, based on the pavement condition. As a result, pilots will notice lower deceleration on a contaminated runway compared to a dry runway.

The FOL contained the following:

CAUTION: The emergency parking brake will always deliver worse performance when compared to the normal brakes with anti-skid protection. Its use is only recommended on abnormal conditions, when the BRK FAIL CAS message is annunciated. In these conditions, applying the landing correction factors, determinate by the QRH, are mandatory.

The FOL further stated,
By definition, a wet runway is a pavement covered by less than 3mm (0.125") of water and the standing water has more than 25% of the pavement covered with more than 3mm of water.Also, be careful when evaluating a light rain over a non-grooved runway or a concrete polished surface. This may result in a slippery surface, which reduces braking action. In this case, the standing water numbers are more recommended than wet.

The FOL states, "CAUTION: The emergency parking brake will always deliver worse performance when compared to the normal brakes with anti-skid protection. Its use is only recommended on abnormal conditions, then the BRK FAIL CAS message is annunciated. In these conditions, applying the landing correction factors, determinate by the QRH, are mandatory."

Accident Rpt# CEN17LA151 **04/08/2017 740 CDT** **Regis# N971QC** **China, TX** **Apt: N/a**
Acft Mk/Mdl GRUMMAN ACFT ENG COR-SCHWEIZER **Acft SN 1655** **Acft Dmg: DESTROYED** **Rpt Status: Prelim** **Prob Caus: Pending**
Eng Mk/Mdl PRATT & WITNEY PT6 **Fatal 0** **Ser Inj 0** **Flt Conducted Under: FAR 137**
Opr Name: TWIN COUNTY AIR-AG INC **Opr dba:** **Aircraft Fire: IFLT**

Events

1. Maneuvering-low-alt flying - Fire/smoke (non-impact)

Narrative

On April 8, 2017, about 0740 central daylight time, a Grumman G-164A agricultural airplane, N971QC, conducted a forced landing near China, Texas. The commercial rated pilot was not injured and the airplane was destroyed during the accident. The airplane was registered to and operated by Twin County Air-AG, Inc. under the provisions of 14 Code of Federal Regulations Part 137 as an aerial application flight. Visual meteorological conditions prevailed at the time.

The pilot reported that he was conducting spraying runs, when he received a low/no oil pressure indication, and a smell of smoke in the cabin. He partly opened the cabin door and noticed flames. The smoke and fire increased, so he selected a field for a forced landing, and exited the airplane. After landing the fire consumed the airplane.

The airplane was retained for further examination.

Accident Rpt# CEN16FA171 05/04/2016 1002 CDT	Regis# N629JK	Reedsville, WI	Apt: N/a	
Acft Mk/Mdl MCDONNELL DOUGLAS HELICOPTER	Acft SN 0542E	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual	Prob Caus: Pending
Eng Mk/Mdl ROLLS ROYCE M250-C20B	Acft TT 7688	Fatal 1 Ser Inj 0	Flt Conducted Under: FAR 133	
Opr Name: ROTOR BLADE LLC	Opr dba:		Aircraft Fire: NONE	
			AW Cert: STN	

Events

1. Maneuvering-hover - Loss of engine power (total)
2. Maneuvering-hover - Loss of control in flight

Narrative

HISTORY OF FLIGHT

On May 4, 2016, at 1002 central daylight time, an MD Helicopters 369E helicopter, N629JK, impacted trees and terrain near Reedsville, Wisconsin. The commercial-rated pilot, who was the sole occupant, was fatally injured, and the helicopter sustained substantial damage. The helicopter was registered to Padgett Ag Air, LLC, Pawleys Island, South Carolina, and operated by Rotor Blade, LLC Georgetown, South Carolina, under the provisions of 14 Code of Federal Regulations (CFR) Part 133 as an external load operation. Visual meteorological conditions prevailed at the time of the accident, and no flight plan was filed. The flight departed from the Manitowoc County Airport (MTW), Manitowoc, Wisconsin, about 0730.

The helicopter was being used to transport personnel and equipment in support of a power line construction project to replace a shield wire with a fiber optic cable. The project began on March 10, 2016, with a basic helicopter and landing zone (LZ) safety course provided by Rotor Blade for the construction employees. The project had continued without interruption except for weather delays. On the morning of the accident, the helicopter arrived at the LZ about 0800. Two job briefings were conducted, and the helicopter was to transport linemen, equipment, and materials to various power line tower structures that were about 125 ft tall using a 50 ft long line attached to the cargo hook. The helicopter flew from 0842 to 0906 and then returned to the LZ.

At 0949, the helicopter departed the LZ and transported two linemen from tower 9903 to the neighboring tower, 9904 (figure 1). When the linemen detached from the long line, the helicopter proceeded to the east and hovered for 2 to 3 minutes. The linemen requested that the helicopter come back to tower 9904 to pick up equipment and return to the LZ. The helicopter approached the tower from the southwest and faced northeast into the wind as the linemen presented hand signals to the pilot. The linemen stated that the end of the long line was about 20 ft laterally and 15 ft vertically from their reach when they noticed the helicopter's sound change and it descended suddenly. The helicopter veered to the right away from the tower, and the main rotor blades slowed noticeably. The helicopter continued into the trees and terrain south of the tower. The linemen climbed down from the tower and heard the helicopter's engine still producing noise. One lineman pulled the emergency fuel shutoff valve and turned off the battery.

Two other project employees were about 150 yards north of tower 9904 (figure 2); they stated that, as the helicopter approached tower 9904 for the final time, the main rotor blades slowed down, the engine sound decreased, and the helicopter veered right toward the ground.

PILOT INFORMATION

The pilot's logbooks were not found during the course of the investigation. Company flight log reports revealed that the pilot flew the accident helicopter from March 8 to May 3, 2016, for a total of 67 hours. The pilot also flew the accident helicopter for an estimated 2.5 hours on the morning of the accident.

HELICOPTER INFORMATION

The MD 369E features a fully articulated five-bladed main rotor system with anti-torque provided by a four-bladed semi-rigid tail rotor. The helicopter was configured to be flown from the left pilot seat (figure 3).The helicopter had accumulated 7,688.4 hours total time (TT) at the time of the accident. A review of the maintenance records revealed an annual inspection was completed on December 4, 2015, at 7,522.6 hours TT. At the time of the accident, the engine, a Roll-Royce 250-C20B, had accumulated 1,048.7 hours TT since new. On April 3, 2016, at 987.4 hours engine TT, a 150-hour engine inspection was completed, and a fuel control tube was replaced. Also replaced during the maintenance work were the engine combustion case, combustion liner, and engine bleed valve due to a power transient over-temperature of 850øC for 2 seconds.

On April 16, 2016, an inoperative power turbine speed (N2) dual tachometer was replaced. On April 26, 2016, a video was taken of the dual tachometer as the helicopter was in flight, and it showed that the dual tachometer indicated about 475 rotor rpm and about 60% N2 rpm. The Rotor Blade ground crewman who took the video stated that the pilot wanted him to send the video to a Rotor Blade mechanic to show him that there was still an issue with the dual tachometer. The Rotor Blade mechanic stated that he watched the video, but it was not sent directly to him. He stated that he told the pilot not to fly the helicopter if there was a problem. The mechanic and the pilot discussed that it was likely only an indicating issue.

The engine was installed new on the helicopter on November 21, 2007. The engine's accessories, including power turbine governor (PTG) model AL-AA2, part number 2549170-1, serial number HR48214, were installed new with 0.0 hours TT. No records indicated any maintenance completed on the PTG after initial installation. The records revealed that all applicable Federal Aviation Administration (FAA) Airworthiness Directives had been completed.

Weight and balance calculations for the helicopter revealed that the center of gravity was within limits, the gross weight at the time of the accident was 2,097 lbs, and the maximum gross weight was 3,550 lbs.

The operator was authorized by the FAA to conduct class A, B, and C external load operations. The helicopter was equipped with an Onboard Systems hydraulic hook kit and Rotor Blade, LLC, H500 side hook assembly.

On May 3, 2016, the company fuel truck was fueled with 211.3 gallons of Jet-A at MTW. The fuel logs revealed that, before the 0800 departure from the LZ, the helicopter was refueled at the fuel truck and departed with 260 lbs of fuel. Before the final departure at 0949, the helicopter was refueled and departed with 240 lbs (35.29 gallons) of fuel, which was estimated to provide 1 hour 10 minutes of flight time.

METEOROLOGICAL INFORMATION

WRECKAGE AND IMPACT INFORMATION

The helicopter came to rest in a wooded area about 125 ft south of tower 9904 (figure 4/5). The surrounding trees were 50 to 75 ft tall, and several of them were broken or showed signs of recent scaring and damage, consistent with the helicopter's impact sequence. All of the major components of the helicopter were found at the accident site. The long line remained attached to the cargo hook and trailed north toward the tower. There was an odor of Jet-A fuel around the main wreckage, and fuel was observed leaking from the helicopter. On-scene documentation was completed, and the wreckage was recovered to a secure examination facility.

On May 5, 2016, a postaccident examination of the wreckage was completed by the investigation team. The main transmission and its mounting revealed no exterior impact damage. The transmission fluid level was verified full using the sight glass. The upper and lower transmission chip detectors were removed and were clear of debris. The gearbox was rotated by hand and exhibited movement to indicate that the transmission internal gearing and the main rotor drive shaft were continuous. The engine drive shaft remained connected at both ends and appeared undamaged. Drive continuity from the engine to the main rotor and tail rotor output pinion was verified. The overrunning clutch was found to be functional.

All five main rotor blades remained attached to the hub and were cut or removed during the examination. The blades exhibited impact damage with minimal signatures of preimpact rotation.

The aft section of the tail boom was fractured and remained attached by the electrical conduit and wiring. The forward section of the tail boom remained attached to the fuselage. There was no evidence of a main rotor blade strike to the tail boom. The tail rotor gearbox and tail rotor swashplate operated smoothly when rotated by hand. The tail rotor gearbox chip detector was clear of debris. The tail rotor blades were manipulated by hand, and the control linkages and mechanisms responded appropriately. The right horizontal stabilizer was crushed inward.

Lateral cyclic control continuity was established through the main rotor head. Longitudinal cyclic control continuity was established to the fractures in the interconnecting torque tube and one-way lock attachment. Beyond the fractures, control continuity was established to the rotor head. The trim actuators were near center position. The actuators could not be electrically tested due to circuit breaker damage. The trim actuators were removed, and the actuators measured between mounting centers. Collective control continuity was established through the main rotor head. Anti-torque control continuity was established from the upper control column bellcrank to the control mechanism fractures under the cockpit floor and back to the fracture in the tail rotor control tube. All breaks in control continuity were consistent with impact damage.

The instrument console and slant panel were still in place but sustained damage primarily on the right side of the slant panel that housed the circuit breaker panel. Although several circuit breaker housings were cracked and some circuit breakers did not appear to reset properly, battery power was applied to evaluate the caution/warning panel lights. The caution/warning lights were functionally tested and illuminated when the push-to-test button was depressed. The engine out warning functioned normally. The trim motors and N2 beep did not function due to impact damage.

An engine fuel vacuum check was performed and revealed a slow leak on the engine side; the system held vacuum on the airframe side. No vacuum check isolation procedure was performed on the engine side since the engine was removed for additional examination. The fuel start pump inlets and the fuel tank sump area were found clean and unobstructed. Fuel was noted within the fuel pump inlet port and at the fuel nozzle. The fuel sender electrical wire was verified to be wrapped around the fuel line preventing interference with the fuel gauge sending unit. About 6 gallons of fuel were drained from the fuel tank sump. The fuel appeared clean with no contaminants observed. The low fuel warning light was functional.

The engine and accessories exhibited minimal external damage, and the engine mounts appeared undamaged. All pneumatic, oil, and fuel lines displayed no damage or evidence of leakage, and all "B" nut connectors were at least finger tight. The compressor inlet and visible stages of blades and vanes revealed no evidence of foreign object debris damage. Upon removal of the engine from the airframe, manual rotation of the gas generator drive train revealed that it was rotationally free and continuous from the starter generator pad to the compressor. Manual rotation of the power turbine drive train revealed that it to be free and continuous from the power take off gear to the stage four turbine wheel. The upper and lower engine chip detectors were clear of debris.

MEDICAL AND PATHOLOGICAL INFORMATION

Manitowoc County Coroner's Office, Fond du Lac, Wisconsin, completed an autopsy on the pilot, and the cause of death was blunt force trauma to the head and chest. The pilot was wearing an MSA LH250 flight helmet during the accident. The Bioaeronautical Research Laboratory at the FAA's Civil Aerospace Medical Institute conducted toxicology testing, which revealed the presence of amlodipine and atorvastatin and was negative for other substances.

Amlodipine (brand name Norvasc) is a prescription medication used to treat high blood pressure. Atorvastatin (brand name Lipitor) is a prescription medication used for lowering high blood cholesterol. The pilot had previously reported these medications to the FAA.

TESTS AND RESEARCH

The engine was shipped to a Rolls-Royce facility and connected to an engine test stand for a functional test. Several attempts to start the engine were made, but the engine did not start. The fuel system was checked, and fuel was noted throughout the system, up to and including the fuel nozzle where normal spray patterns and pressures were observed. The fuel control unit was removed and replaced with a new fuel control unit; subsequent engine start attempts were unsuccessful. The governor servo pressure (Py) line between the PTG and fuel control unit was removed, and its fittings were capped off to test operation of the PTG. A successful engine start was made in this condition. The PTG was removed, and its main drive shaft was found fractured. The original PTG was replaced with a new PTG, and the original fuel control was reinstalled on the engine. With the new PTG installed, the engine started normally, produced rated horsepower, and met production test specifications with no anomalies noted.

On August 9, 2016, the PTG, which was designed and manufactured by Honeywell, was disassembled and examined at a Honeywell facility under the auspices of the NTSB. A functional performance test could not be performed due to the internal damage. The examination revealed that the governor pressure (Pg) lever clevis fork was bent, and the spool bearing assembly was loose within the drive body cavity (figure 6). The drive shaft guide post was fractured and trapped within the spool bearing bushing. Metallic debris was found within the interior of both the drive body and the drive body cover. The internal bearing elements of the spool bearing assembly were seized and would not rotate. One flyweight was bent and did not pivot freely. The drive shaft was found fractured at the guide post and at the drive spline. The PTG was sent to the NTSB Materials Laboratory, Washington, DC, for further examination.

On September 16, 2016, the NTSB examination of the PTG revealed that a portion of the fractured drive shaft remained embedded in the spindle of the spool bearing assembly. The fracture surface features of the shaft were consistent with overstress. The outer cap of the spool bearing assembly was removed, and the ball bearings and spacers were found coated with voluminous, powdery, black particulate. Much of the powder fell from the assembly upon removal of the cap. No grease was observed. Disassembly of the bearings revealed that the ball retainers were fragmented, the inner surfaces were found coated with a powdery, black particulate, and no grease was observed. The inner bearing surfaces were rough and frosted. Figure 7 shows the disassembled pieces of the spool bearing.

ADDITIONAL INFORMATION

14 CFR Part 133 Operations Specifications
The Operations Specifications for Rotor Blade, LLC, as approved by the FAA, states:
The owner or operator of the aircraft identified in the certificate holder or operator' s aircraft listing is primarily responsible for maintaining that aircraft in an airworthy condition as required by 14 CFR 91.403(a) and Part 39.

PTG Information

According to the component maintenance manual, the model AL-AA2 PTG is an element of the engine fuel controlling system. The function of the governor is to maintain the speed of the power turbine (N2) by resetting the main fuel control; the PTG supplements the main fuel control. This resetting establishes the gas producer speed (N1) required to supply N2. The PTG is mounted on the accessory case and senses N2 speed through reduction gearing. When an N2 off-speed condition is sensed by the PTG, it supplies a signal to the fuel control to change N1 speed to eliminate the off-speed condition. A complete description of the PTG is available in the public docket for this accident.

In 2003, Honeywell introduced a dual-spool bearing for the PTG to lower cost of ownership and commonize the design. The bearing installed in the accident PTG was the dual-spool bearing. The dual-spool bearing replaced the legacy design single-spool bearing; the legacy design had no previous service issues. Honeywell reported that the dual-spool bearing had experienced a total of 23 field failures before this accident. The spool bearing failures led to either engine oscillations, uncommanded engine acceleration, or a loss of engine power.

Honeywell Service Bulletin (SB) GT-73-344

Honeywell issued SB GT-73-344, Revision 2, on October 30, 2008, to replace the bearing assembly on PTGs used on Rolls-Royce 250 series engines in order to increase PTG reliability. The SB applied to several PTG models including the AL-AA2 model on the accident engine. Revision 1 was issued March 7, 2008.

Rolls-Royce Commercial Engine Bulletin (CEB) 1402

Rolls-Royce issued CEB 1402 on April 21, 2008, to increase PTG reliability by incorporating a new bearing assembly. The CEB referenced Honeywell SB GT-73-344 and specified compliance times. The SB and CEB were issued after the accident PTG was installed new, and the SB and CEB were applicable to it. According to the CEB compliance times, the accident PTG's dual-spool bearing should have been replaced with a single-spool bearing no later than 750 hours TT since new.

As a result of this investigation, Rolls-Royce issued a Commercial Service Letter (CSL), revision 1, on November 11, 2016, to remind customers that there are engines operating in the field that have not complied with CEB 1402 and other CEBs. The CSL recommends that customers should review the referenced CEBs to determine if they are applicable to their engine. The CSL also states: "Rolls--Royce has been involved in investigations where failure of the user to comply with the identified bulletins resulted in an uncommanded engine power reduction. It is the owner/operator's sole responsibility to comply with the identified bulletins within the specified timeframe or risk a potential for loss of aircraft or loss of life. Rolls-Royce is not responsible for an owner/operator's failure to comply."

Accident Rpt# GAA17CA139 12/02/2016 1630 EST	**Regis# N4149R**	**Midland, VA**	**Apt: Warrenton-fauquier HWY**
Acft Mk/Mdl PIPER PA46-350P	**Acft SN 4636226**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl PRATT & WHITNEY PT6A-35	**Acft TT 2165**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: ELMWOOD AVIATION LLC	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: STN

Summary

The pilot receiving instruction reported that, during an annual insurance flight review, he was told to perform a short-field landing for the final landing. The flight instructor told him to be "50 ft. over the numbers at 75 KIAS [knots indicated airspeed], then go to flight idle, push the nose down, and land short." On short final, the pilot obtained the target altitude and airspeed, then reduced the power to flight idle, and the airplane dropped rapidly. He advanced the power lever, but the turbine-powered engine was slow to respond due to the spool-up lag, and the airplane landed hard and bounced. The pilot reported they taxied back to the hangar with no further incident.

The airplane sustained substantial damage to the fuselage.

The substantial damage was discovered later during a Federal Aviation Administration evaluation for repairs for a ferry permit. The ferry permit was submitted after receiving an engineering evaluation on the structure of the fuselage to allow the company to fly the airplane to a more appropriate repair station.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation.

The flight manual for the PA-46-350P states: "for a short field technique, flaps are to be full down, airspeed 78 KIAS, throttle as required. Once over the obstacle on final, throttle reduced to idle. After touchdown, brakes maximum."

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's improper landing flare and subsequent hard landing while demonstrating a short-field landing and the flight instructor's delayed remedial action.

Events

1. Landing-flare/touchdown - Hard landing

Findings - Cause/Factor

1. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Landing flare-Not attained/maintained - C
2. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
3. Personnel issues-Action/decision-Action-Delayed action-Instructor/check pilot - F
4. Personnel issues-Psychological-Attention/monitoring-Monitoring other person-Instructor/check pilot - F

Narrative

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National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA17CA158 02/27/2017 1220 PST	**Regis# CGWVS**	**Bellingham, WA**	**Apt: Bellingham Intl BLI**	
Acft Mk/Mdl SOCATA TBM700-B	**Acft SN 210**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual**	**Prob Caus: Pending**
Eng Mk/Mdl P&W CANADA PT6A-64	**Acft TT 1962**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**	
Opr Name: 4197802 MANITOBA LTD.	**Opr dba:**		**Aircraft Fire: NONE**	

Summary

The pilot reported that, during the preflight, it was snowing, and he wiped the snow that had accumulated on the wings off "as best as [he] could." He added that, while taxiing to the runway, "snow was falling heavily," and he observed "light accumulation of wet snow" on the wings. During the takeoff roll, he observed the snow "sloughing off" the wings as the airspeed increased. Subsequently, during the climb to about 150 ft above the ground, the airplane yawed to the left, and he attempted to recover using right aileron. He reported that he "could see a stall forming," so he lowered the nose and reduced power to idle. The airplane impacted the general aviation ramp in a left-wing-down attitude and slid 500 to 600 ft.

The pilot reported on the National Transportation Safety Board Aircraft Accident/ Incident Report 6120.1 form that the airplane stalled, and he recommended "better deicing" before takeoff.

The airplane sustained substantial damage to the fuselage and left wing.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation.

A review of recorded data from the automated weather observation station located on the airport revealed that, about 27 minutes before the accident, the wind was 010ø at 8 knots, 1/2-mile visibility, moderate snow, freezing fog, and sky condition broken at 500 ft above ground level (agl) and overcast at 1,500 ft agl. The airplane departed from runway 16.

The Federal Aviation Administration (FAA) Aeronautical Information Manual stated, in part: "The presence of aircraft airframe icing during takeoff, typically caused by improper or no deicing of the aircraft being accomplished prior to flight has contributed to many recent accidents in turbine aircraft."

The manual further stated, "Ensure that your aircraft's lift-generating surfaces are COMPLETELY free of contamination before flight through a tactile (hands on) check of the critical surfaces when feasible. Even when otherwise permitted, operators should avoid smooth or polished frost on lift-generating surfaces as an acceptable preflight condition."

FAA Advisory Circular, AC 135-17, stated in part: "Test data indicate that ice, snow, or frost formations having thickness and surface roughness similar to medium or course sandpaper on the leading edge and upper surfaces of a wing can reduce wing lift by as much as 30 percent and increase drag by 40 percent."

Included in the public docket for this report is a copy of a service bulletin from the airplane manufacturer, which describes deicing and anti-icing ground procedures. It stated, in part:

During conditions conducive to aeroplane icing during ground operations, take-off shall not be attempted when ice, snow, slush or frost is present or adhering to the wings, propellers, control surfaces, engine inlets or other critical surfaces.

This is known as the "Clean Aircraft Concept". Any deposit of ice, snow or frost on the external surfaces may drastically affect its performance due to reduced aerodynamic lift and increased drag resulting from the disturbed airflow.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to properly deice the airplane before takeoff, which resulted in an aerodynamic stall during the initial climb.

Events

1. Prior to flight - Miscellaneous/other
2. Takeoff - Loss of control in flight
3. Takeoff - Attempted remediation/recovery
4. Takeoff - Collision with terr/obj (non-CFIT)

Findings - Cause/Factor

1. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
2. Personnel issues-Action/decision-Action-Incomplete action-Pilot - C
3. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Angle of attack-Capability exceeded - C
4. Environmental issues-Conditions/weather/phenomena-Ceiling/visibility/precip-Snow-Effect on equipment - C
5. Environmental issues-Conditions/weather/phenomena-Wind-Tailwind-Effect on operation
6. Personnel issues-Action/decision-Info processing/decision-Decision making/judgment-Pilot

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Narrative

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